Brian P. Grady
Douglas and Hilda Bourne Chair of Chemical Engineering

Chemical, Biological and Materials Engineering
The University of Oklahoma

Thursday,
October 11, 2018
11:00 a.m.
171 Durham Center
Iowa State University

Adsorption of Surfactants at the Solid-Liquid Interface: Effect of Surface Topological Variations

Adsorption of surfactants at the solid-liquid interface is key to many applications, including the removal of particulates from laundry or hard surfaces, the removal of oil from underground, deinking of plastics and the separation of minerals, e.g. copper and lead from other species. Our group has studied in detail the effect of topological variations on surfactant adsorption using both experimental and molecular dynamic (MD) simulations. On a surface that is not molecularly smooth but where variations in topology are random, we have shown that with an increase in variation, the amount of surfactant adsorption decreases on a total surface area basis, and, in some cases, even on a nominal surface area basis (e.g. the surface area assuming the surface is molecularly smooth). Two types of controlled topological variations have been explored by our group, the bottom of trenches with varying trench widths, and on top of pillars with varying pillar size. The bottom of the trenches and the tops of the pillars were molecular smooth. In both cases, changes in morphology were determined using force measurements with an AFM probe. In the trench case, we were only able to measure the center of the trench and the thickness of the surfactant layer was identical within experimental error to the thickness adsorbed on a surface with no topological variation while the amount of surfactant adsorbed, as measured by forces, was less. In the pillar case, the thickness was higher near the edge of the pillar and decayed exponentially with distance from the edge with a decay-length constant of ~10 nm while the amount adsorbed was less near the edge and increased exponentially with a slightly larger decay-length constant. These decay length constants are much larger than expected given the ~2 nm size of a surfactant molecule and are also much larger than MD simulations. Surfactant driven by entropy and known to be highly cooperative, and these large decay constadsorption is ants as well as the decrease in total amount adsorbed on a rough surface are a manifestation of the cooperativity of surfactant adsorption.

Brian Grady received a B.S in Chemical Engineering from the University of Illinois in 1987, worked at Procter and Gamble for two years, and then attended graduate school and obtained a Ph.D. from the University of Wisconsin in 1994, also in Chemical Engineering. Since 1994, he has been employed by the University of Oklahoma as a faculty member in the School of Chemical, Biological and Materials Engineering, being appointed to the position of Director in 2014. He currently holds the Douglas and Hilda Bourne Chair of Chemical Engineering at the University of Oklahoma. He also serves as the Director of the Institute for Applied Surfactant Research at the University at Oklahoma, an industrial consortium with 10 corporate members. Finally, he is currently serving as the President of the Society of Plastics Engineers.